

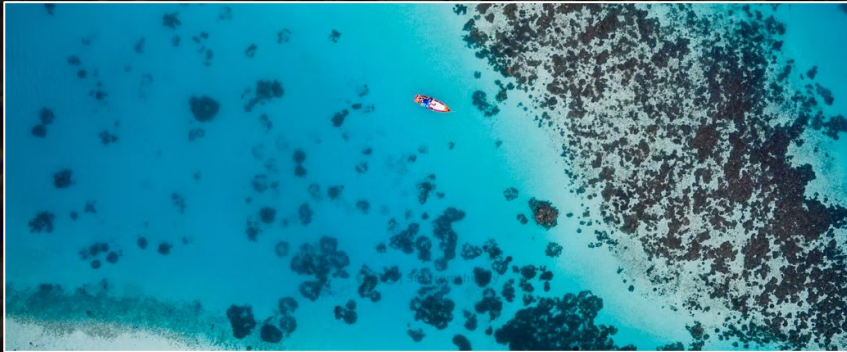
Coral Reefs

Marine Science Notes



Coral reefs form where conditions include:

- water temps of 23-25°C
- shallow, plenty of sunlight
- no exposure at low tide
- clear, sediment-free water with few nutrients
- hard substrate (for attachment)
- salinity of 32-38 ppt



Video

Coral Reefs
101

Types of Coral Reefs

- Reefs growing close to the shore are called **fringing** reefs



- Reefs that are separated from shore by a **lagoon** are called **barrier** reefs
 - **Patch** reefs can occur within those lagoons



- Reefs surrounding a lagoon but little or no land are **atolls**
 - Over time, volcanic islands disappear (sinking/erosion), but the reef that grew around them remains
 - fringing reefs → barrier reefs → atolls

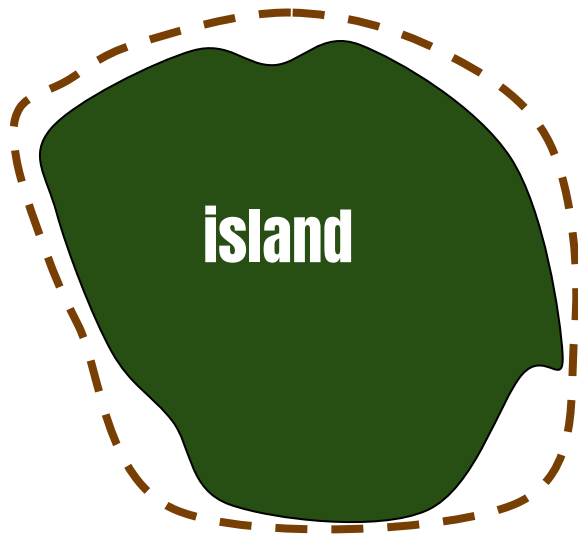


Notebook Activity #1

Types of Coral Reefs

1. Create an illustration similar to the ones below to include all three reef types.
2. Use a color key to indicate the features of each reef type where necessary.
3. Be sure to label the reef types.
4. Below that, describe what is happening in each location in reference to the coral reef.

 = reef  = lagoon  = patch reef



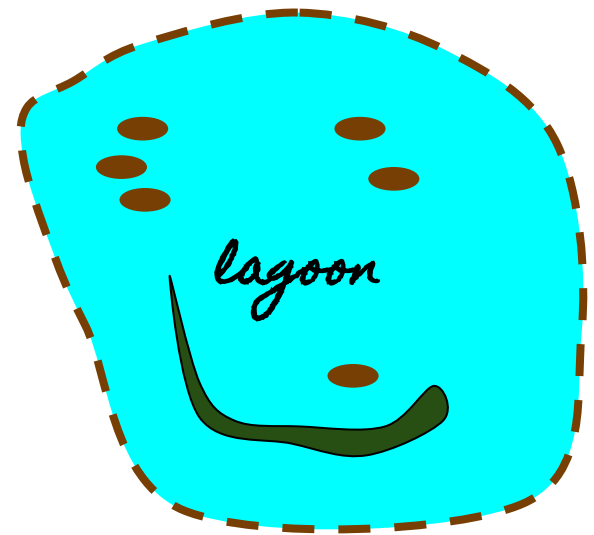
Reef type = _____

Describe what is happening



Reef type = _____

Describe what is happening



Reef type = _____

Describe what is happening

Zones of a reef

- The lagoon gradually builds higher (**back reef**) with increasing coral cover until it reaches its highest point (**reef crest**)
 - waves break over the crest
- From the crest, the reef drops off into deep water (**fore reef**) sometimes forming a “wall” of coral





- lagoon

- back reef

- reef crest

- fore reef



Are corals plants or animals?

- Coral **polyps** are animals belonging to the phylum **Cnidaria**
 - this phylum also includes jellyfish and sea anemones
 - characterized by stinging tentacles and symbiotic algae
- Tentacles are used to capture prey and contain harpoon like, organelles called **nematocysts** that contain toxins
- Larval corals attach to hard substrate by a **basal plate** and grow a colony by budding (cloning)

- Reef-building **hard corals** build a cup-like **calyx** around themselves made of calcium carbonate (CaCO_3)
 - *Examples:* Elkhorn coral, brain coral
 - Corals in a colony connect their calyces, building together
 - When an older polyp dies, a new polyp grows in its place and continues to secrete CaCO_3
 - These build up over time, forming the shapes and framework of the reef

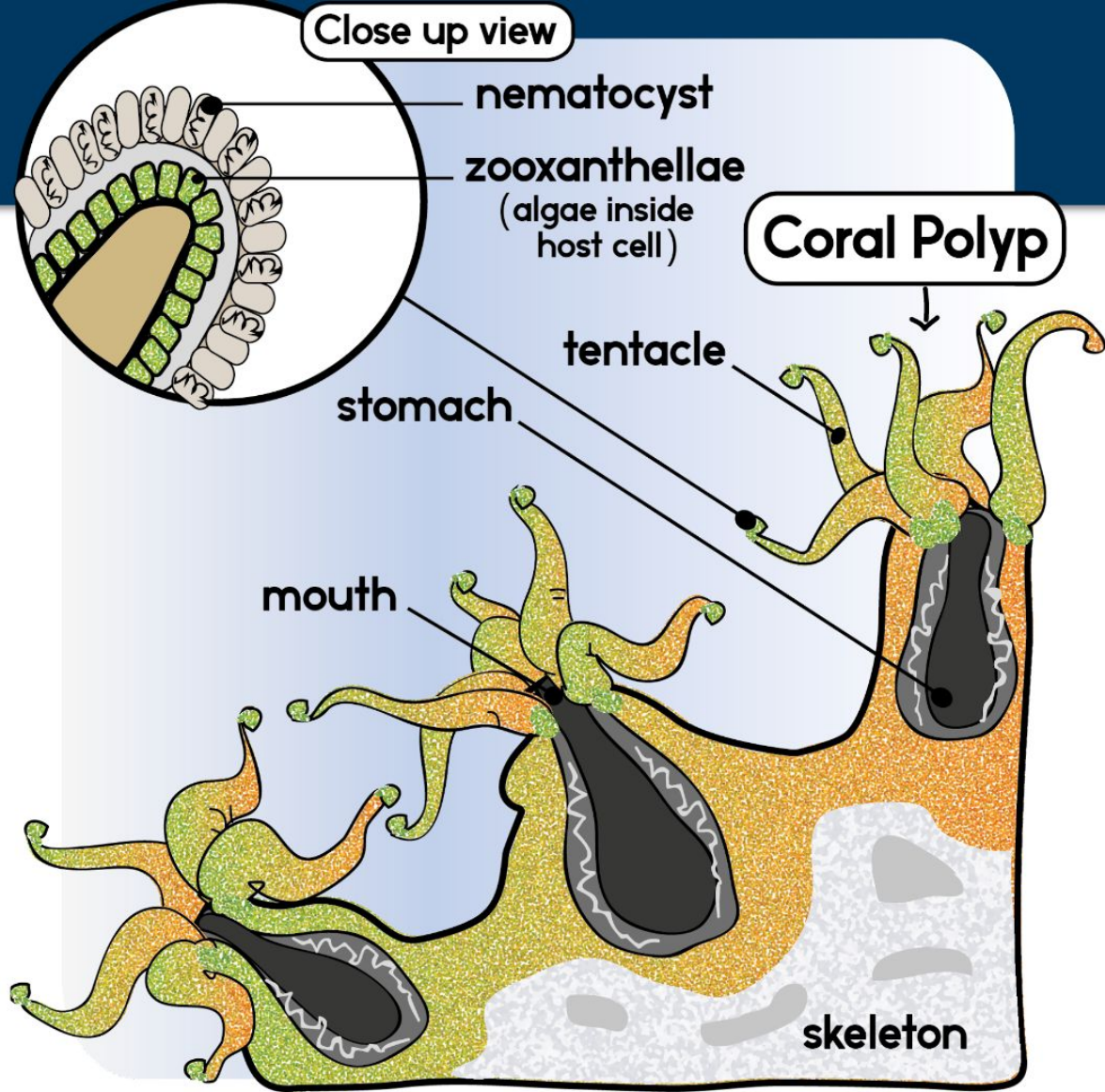


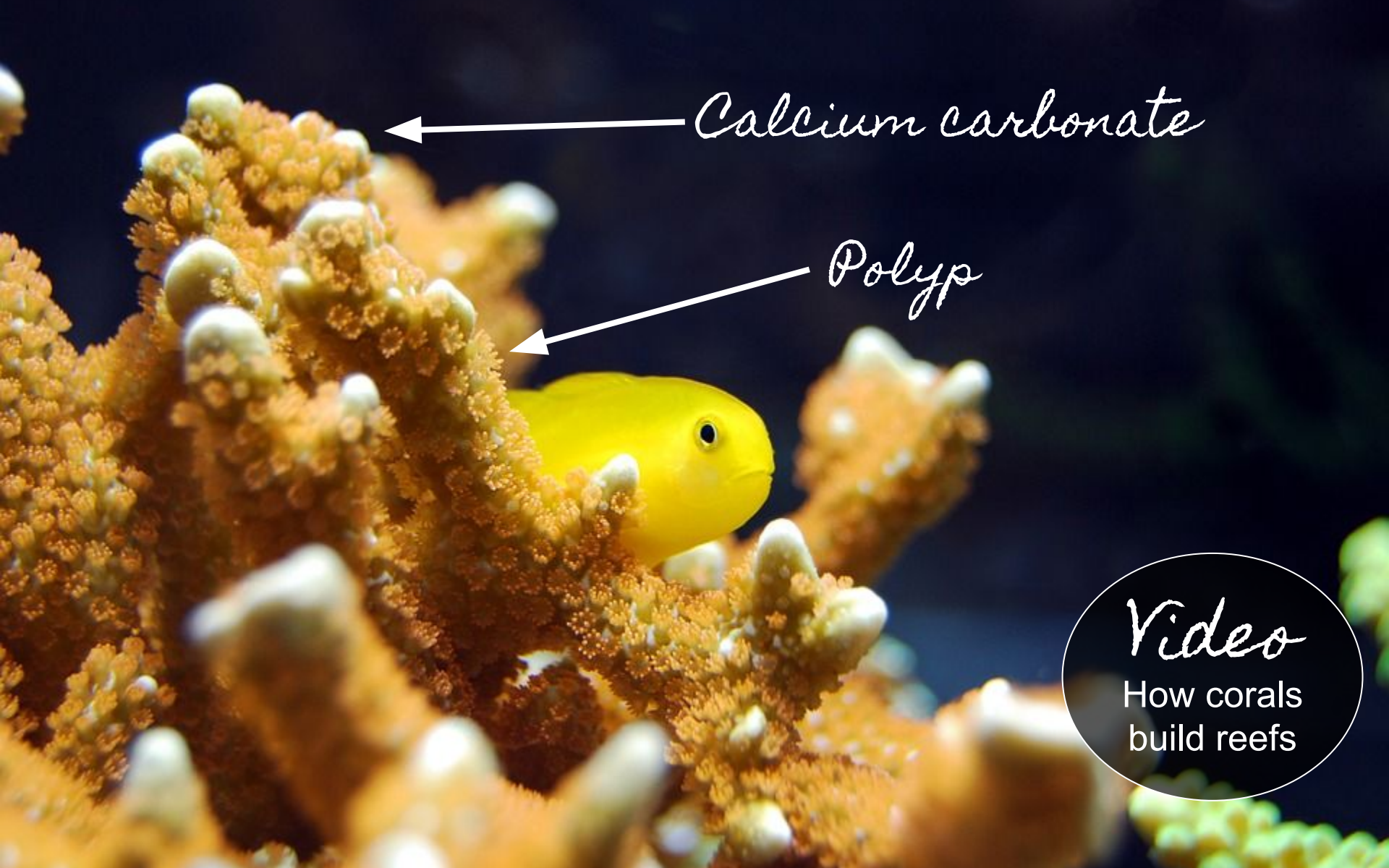
calyx = "cay-likes"

Notebook Activity #2

Coral Polyp Diagram

1. Cut out and paste the blank diagram onto your notebook page.
2. Color the polyp tissue any color you want.
3. Color the skeleton grey.
4. Label all of the parts of the coral polyp onto your page.





Calcium carbonate

Polyp

Video

How corals
build reefs

living polyps



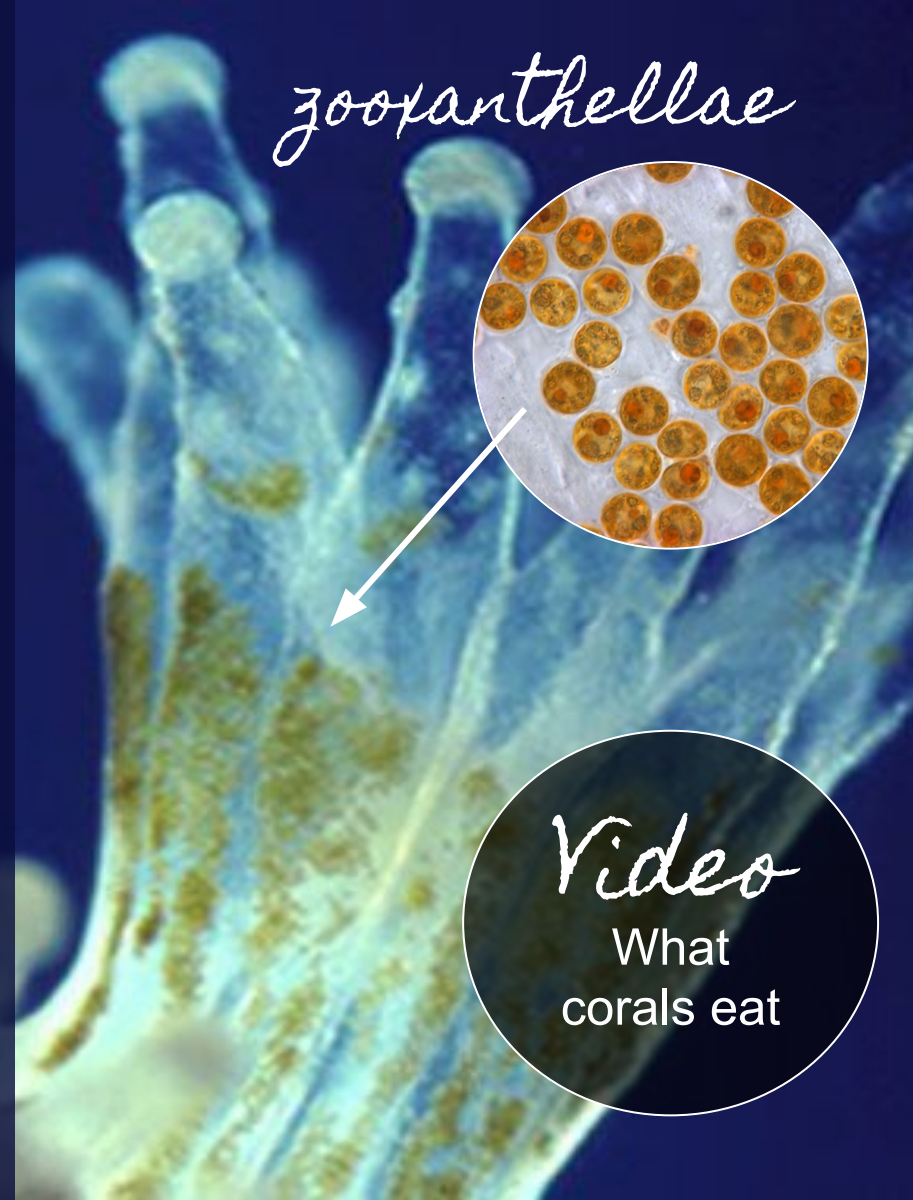
*dead
skeleton*





dead
coral
skeleton

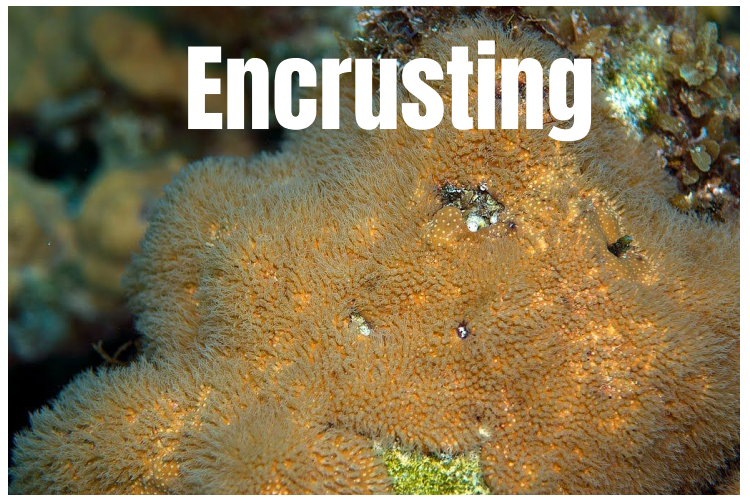
- Polyps have a symbiotic dinoflagellate (algae) living within their tissues called **zooxanthellae**, which need sunlight for photosynthesis
 - Mutualism - they cannot survive without each other
 - Coral provides nutrients and CO_2
 - Algae provides sugars and lipids to corals
 - ***Hard corals cannot build reefs without them***



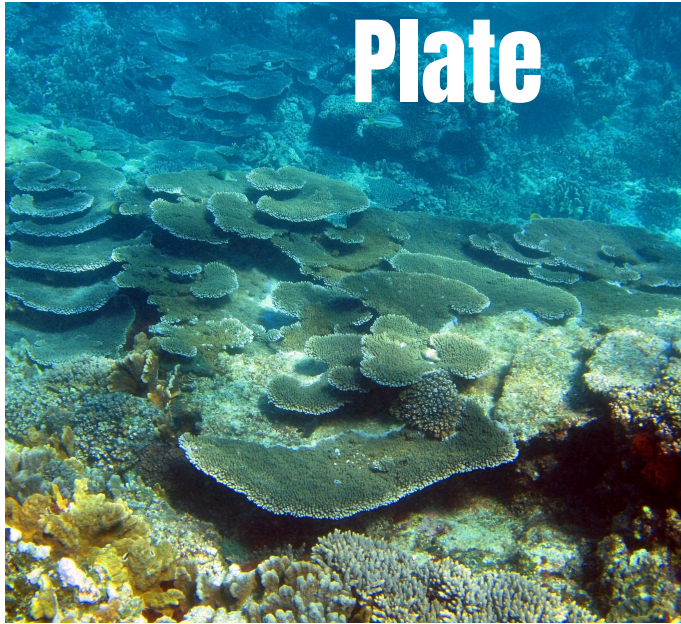
Branching



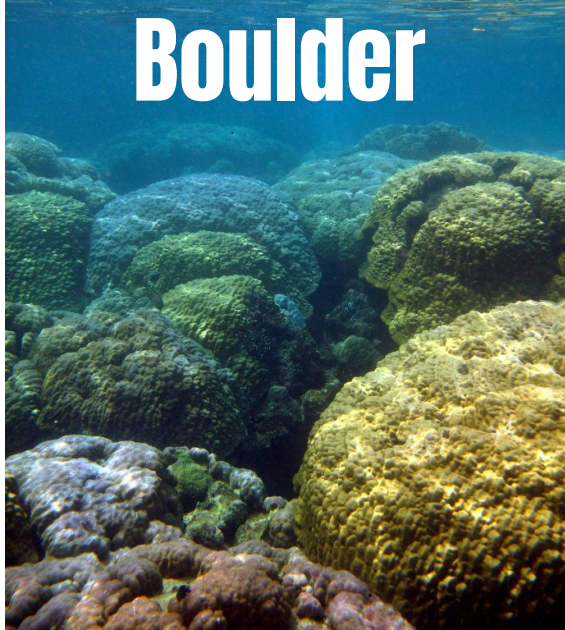
Encrusting



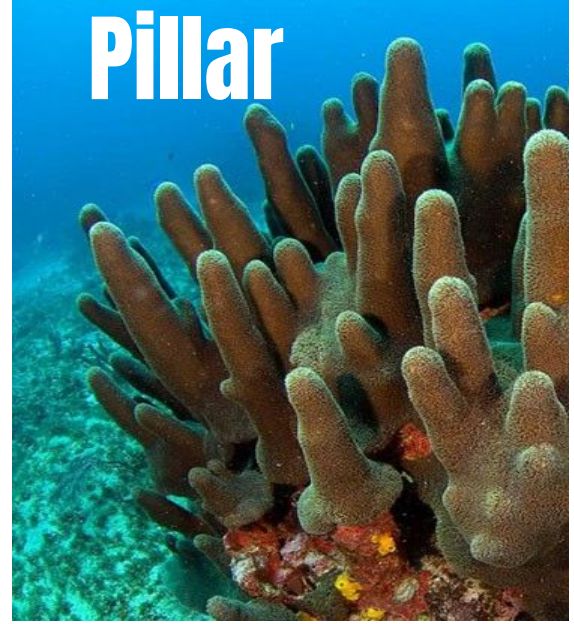
Plate



Boulder



Pillar



- **Soft corals** do NOT have a calcified skeleton and generally do NOT have a relationship with zooxanthellae
 - *Examples:* Sea fans, sea rods, and sea whips (**gorgonians**)

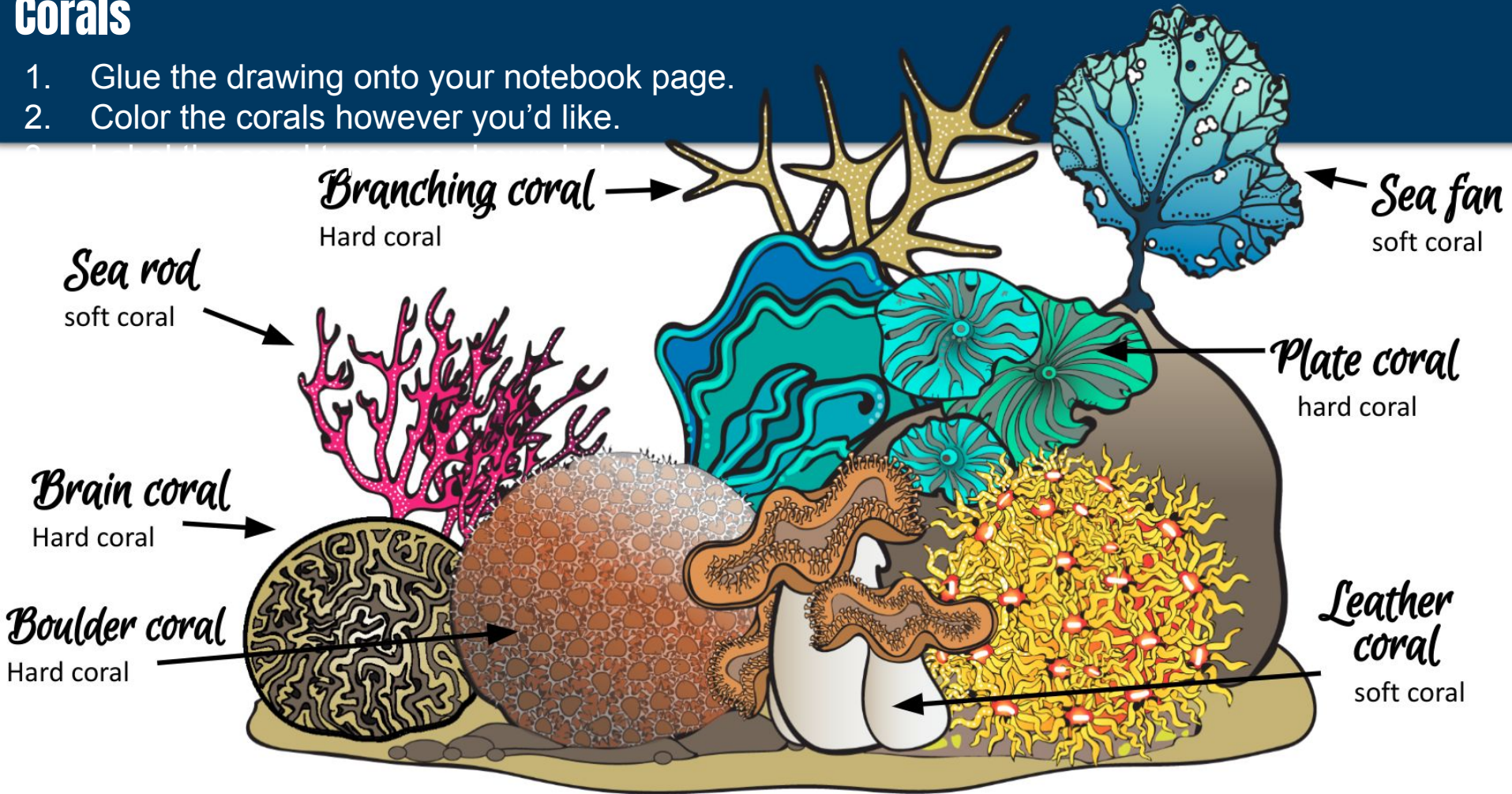


Notebook Activity #3

Corals

1. Glue the drawing onto your notebook page.
2. Color the corals however you'd like.

Types of



How do corals reproduce?

- **Sexual reproduction**

- spawning of eggs and sperm and allows for larvae to drift with corals and settle new reefs

- **Asexual reproduction**

- budding - parent coral polyp clones itself and colonies are formed
- allows coral to expand or grow outwards



Importance of coral reefs

- Reefs protect shorelines from erosion - they absorb 97% of wave energy and reduce wave heights
- Biodiversity - corals are home to over 25% of all marine life
- Food source - fish, crustacean, shellfish, etc
 - some nations depend almost entirely on reefs as their protein source
- Recreation and tourism on reef generates \$35 billion each year and creates jobs
- Some species may hold the cures for diseases



5-20 mm/yr

slow growing corals

20 cm/yr

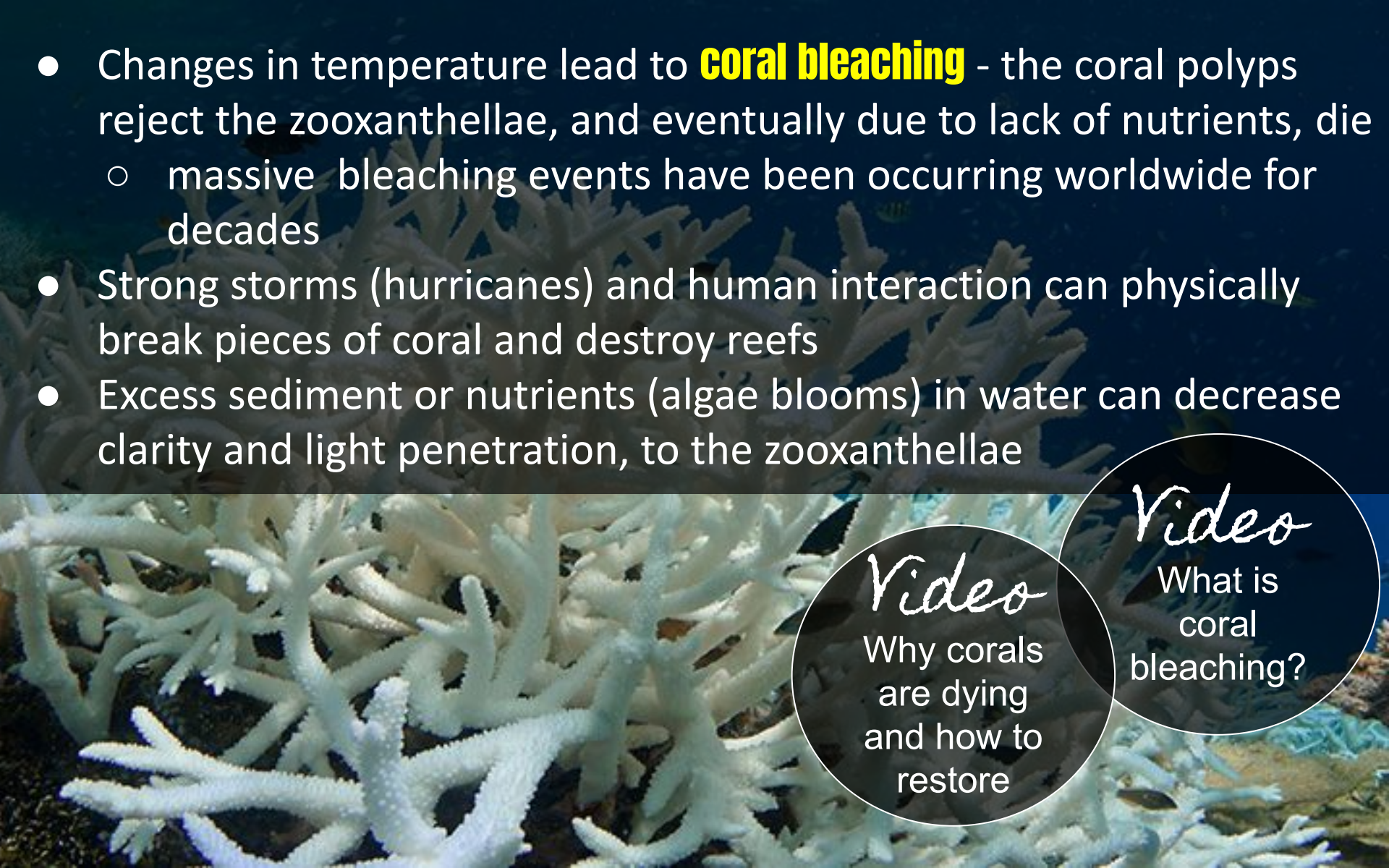
fastest growing corals

Video

acidification
and coral
reefs

Reef Erosion occurs when a coral is losing more of its CaCO_3 skeleton per year than it is gaining

- ↓ in pH (**ocean acidification**) reduces corals ability to absorb the carbonate they need to build calyxes
 - the cause is increased CO_2 in the atmosphere, which means more CO_2 in the ocean.
 - $\text{CO}_2 + \text{H}_2\text{O} = \text{carbonic acid (an acid)}$
- **Bioerosion** is caused by other living organisms
 - crown of thorns and parrotfish both eat coral - a delicate balance is needed for these populations

- 
- Changes in temperature lead to **coral bleaching** - the coral polyps reject the zooxanthellae, and eventually due to lack of nutrients, die
 - massive bleaching events have been occurring worldwide for decades
 - Strong storms (hurricanes) and human interaction can physically break pieces of coral and destroy reefs
 - Excess sediment or nutrients (algae blooms) in water can decrease clarity and light penetration, to the zooxanthellae

Video

Why corals
are dying
and how to
restore

Video

What is
coral
bleaching?

- Many coral reefs have undergone **phase shifts** - this is when a community is unable to return to original state, and shifts to a new one
 - This has occurred in cases where the grazers (urchins or fish that eat macroalgae from reefs) are removed, and the macroalgae outcompetes the coral for space.
 - Most reef animals will disappear from the reef after this



Artificial Reefs can restore biodiversity

- artificial materials are used to provide hard substrate for corals to establish colonies in a new location and build a reef structure → this attracts fish
 - old tires
 - old cement from bridges
 - old ships

Coral farming is becoming popular

- branching (fastest growing) corals are grown on a farm and then relocated onto a reef



coral farm

Video

shipwrecks
as artificial
reefs

ship